Galactic Structure and Near-Field Cosmology via Astrometry with ODI

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-Science Objectives

-Preliminary Astrometric Results with OPTIC on WIYN

-Planned Early-release Results

Science Objectives

Milky Way dwarf spheroidals:

"missing" satellite problem → subhalo mass distribution → tidal effects on mass determinations → accurate orbits → accurate absolute proper motions

origin → cosmological substructures or tidal dwarf galaxies? → distribution of orbital angular momentum → orbits → accurate absolute proper motions

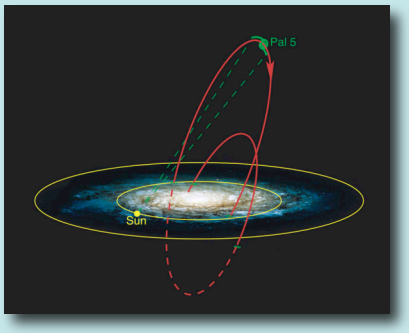
targets: 9 satellites within 90 kpc (δ >-15°)

Milky Way globular clusters:

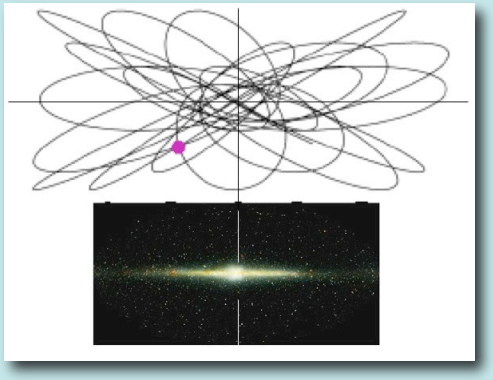
formation of the MW globular cluster (GC) system → accretion vs dissipational collapse? → chemical & kinematic signature → orbits → accurate absolute proper motions

nature of most massive, multiple-population GCs → nuclei of disrupted satellites? → kinematic signature → orbits → accurate absolute proper motions

targets: 30 candidate GCs (δ >-15°)



www.sdss.org



Freeman 2007, Dinescu et al. 1999

Science Objectives

Tidal streams:

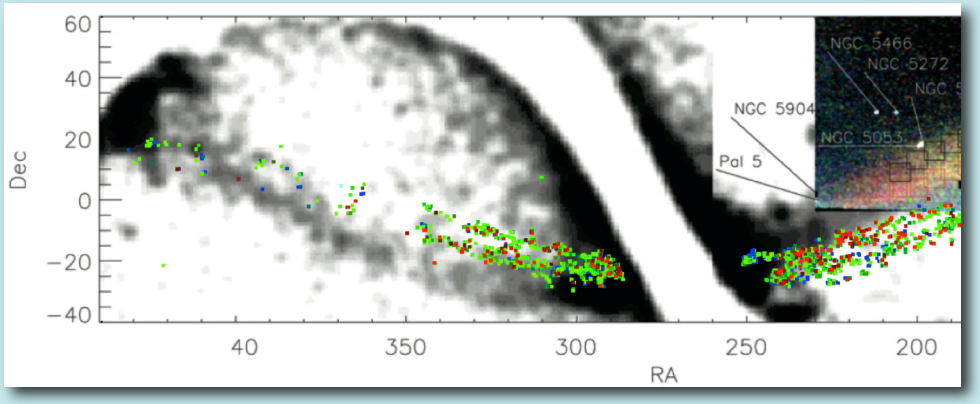
shape of the Galactic potential & satellite disruption processes → 3D velocities of stars in tidal streams → accurate absolute proper motions

targets: Sgr stream, Mon stream, Virgo Overdensity, possibly a few others

Main Milky-Way components (thin, thick disks and halo):

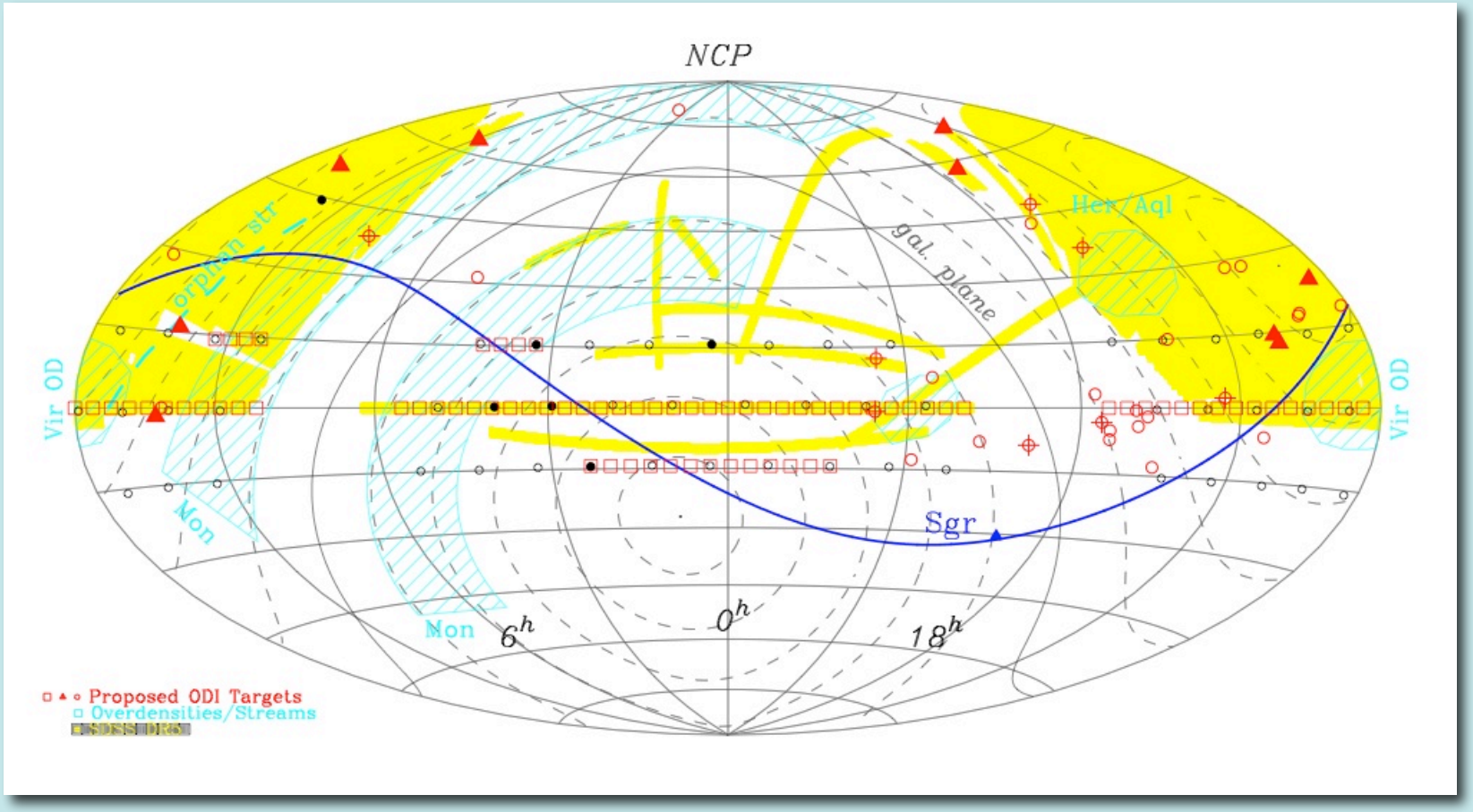
formation in a cosmological context → mean velocities and velocity dispersions as a function of distance from the Galactic plane and center → accurate absolute proper motions

targets: ~3 main fields, plus along the lines of sight to streams, globular clusters and dwarf satellites



Keller et al. 2008

Science Objectives



Comparison of Astrometric Precision

System	Precision (mas)	FOV / Area	Scale (“/pix)	Reference
HST+ACS/WFC	1	3.3′x3.3′ 0.003 sq deg	0.049	Anderson & King 2006, 2007
HST+WFPC2	1	1.3′x1.3′ (x3) 0.0014 sq deg	0.1	Anderson & King 2003
ESO2.2m+WFI	7	34′x34′ 0.32 sq deg	0.24	Anderson et al. 2006
WIYN+OPTIC	2	9.6′x9.6′ 0.026 sq deg	0.14	This work and Vieira et al. 2005
WIYN+ODI	2	60′x60′ 1.0 sq deg	0.11	Projected

Preliminary Astrometric Results with OPTIC on WIYN

The Orthogonal Parallel Transfer Imaging Camera (OPTIC) consists of two 2K x 4K chips mounted side by side in a dewar.

Table 1-1: CCD parameters

Parameter	Value
pixel size	15 μm
pixel size	0.14 arcsec
readout time (unbinned)	25 sec
readout time (binned 2x2)	8 sec
CCD thickness	45 μm
read noise	4 e^-
gain	1.4 e^-/ADU
full well	> 80k e^-
non-linearity	< 1% to ~30k ADU
gap between CCDs	104 pixels=14 arcsec
dewar hold time	~8 hour

FOV: 9.6 x 9.6 arcmin

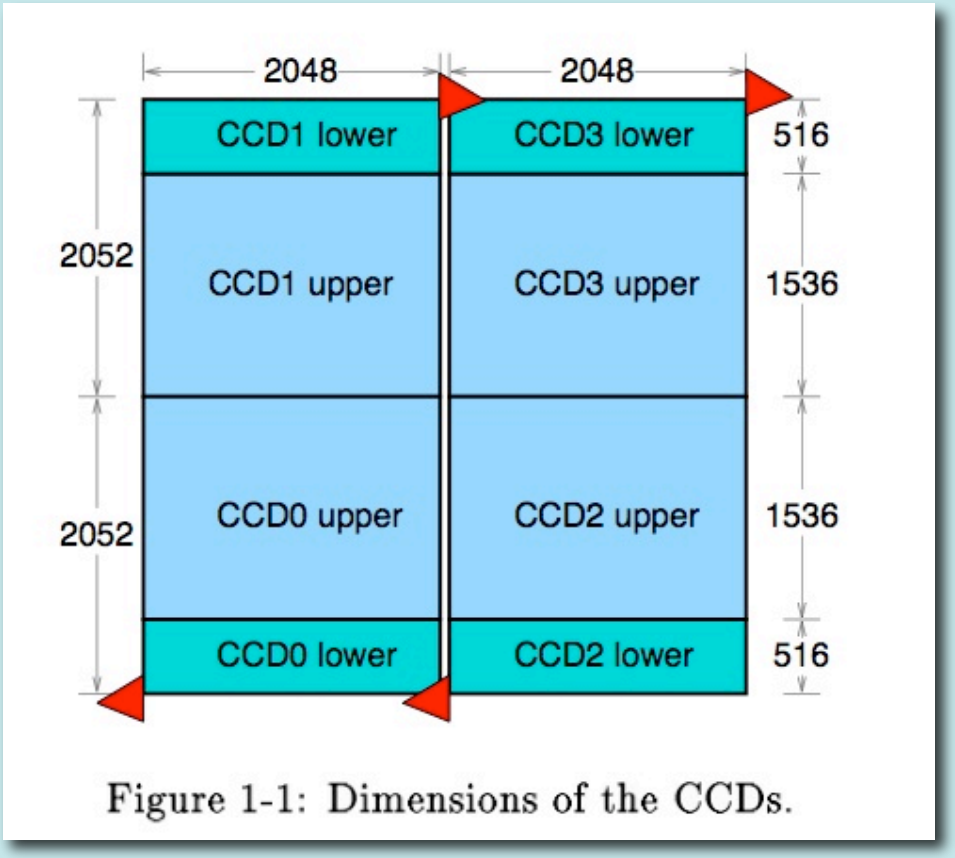


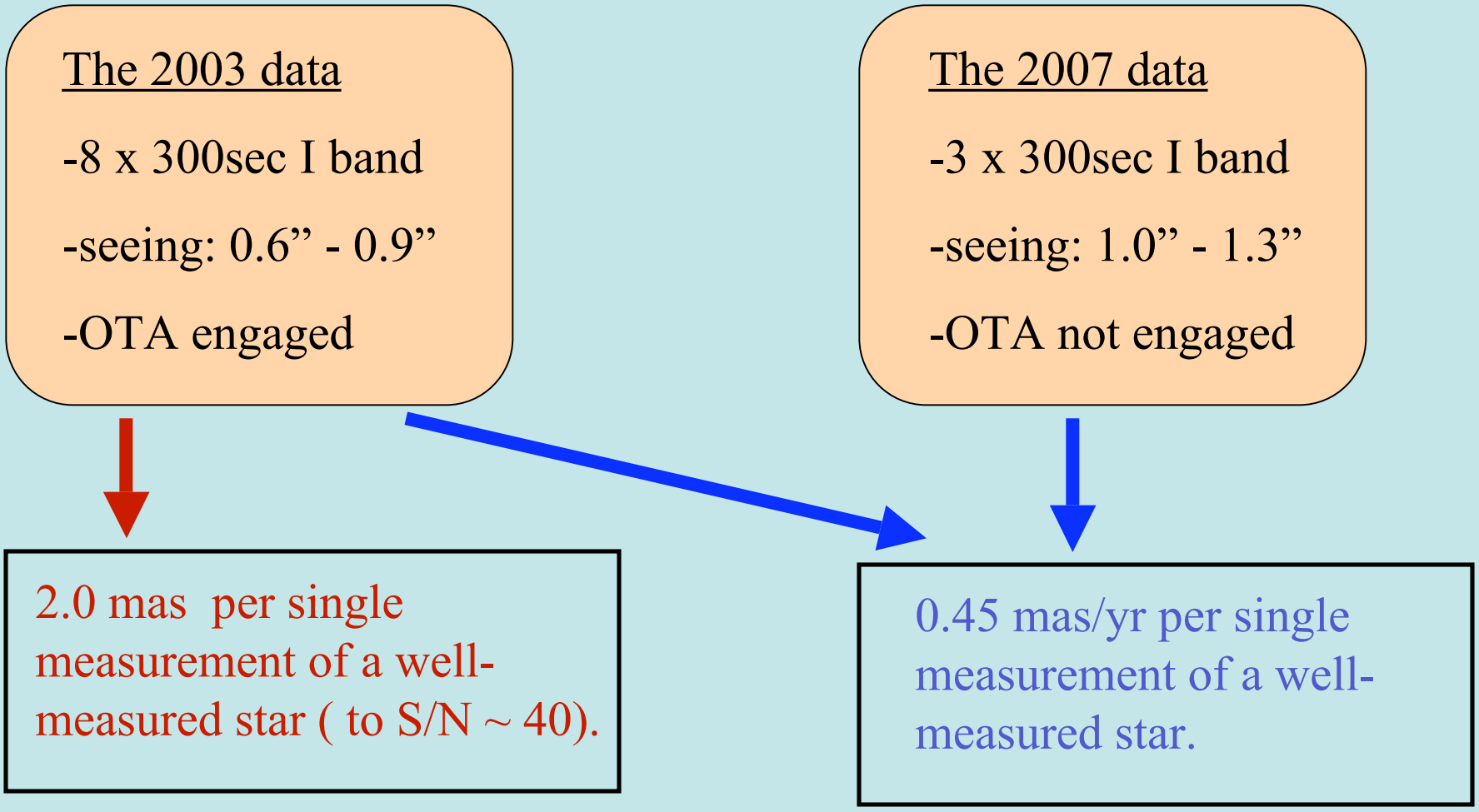
Figure 1-1: Dimensions of the CCDs.

www.noao.edu/wiyn/instrument

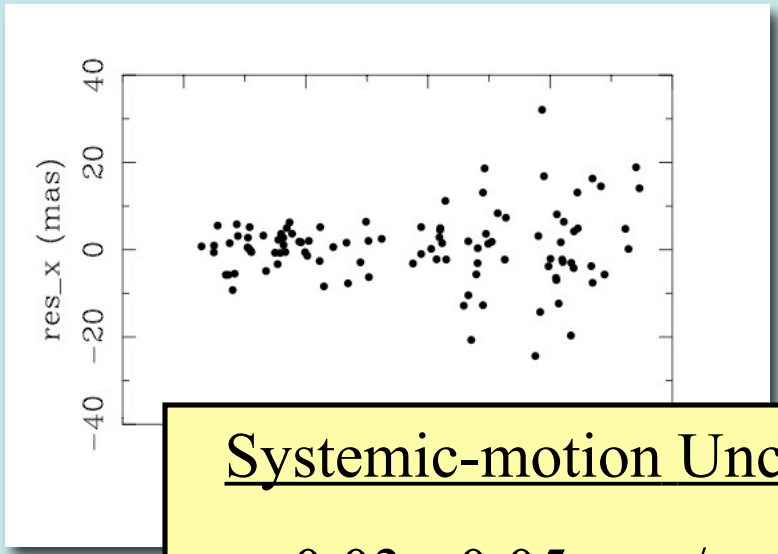
Tonry and Howell 2004

Preliminary Astrometric Results with OPTIC on WIYN

Observations of open cluster NGC 188 in 2003 and 2007



Preliminary Astrometric Results with OPTIC on WIYN



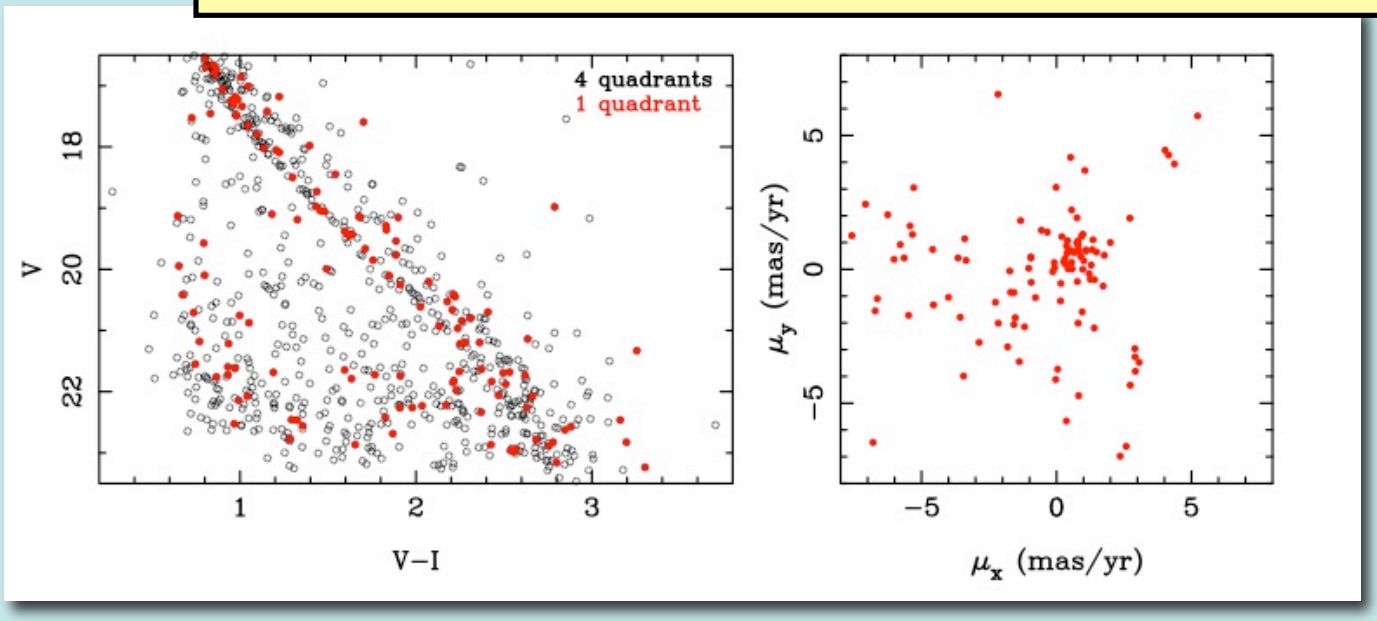
At V ~ 20, S/N ~ 40:

σ = 2 mas

σ_μ = 0.45 mas/yr (4-year baseline)

Systemic-motion Uncertainty for GCs and dSphs

~ 0.03 - 0.05 mas/yr => 7 to 12 km/s at 50 kpc



Photometric errors (all 2003 data):

V	σ_V
20.0	0.003
21.0	0.005
22.0	0.009
23.0	0.029

Planned Early-Release Results with ODI

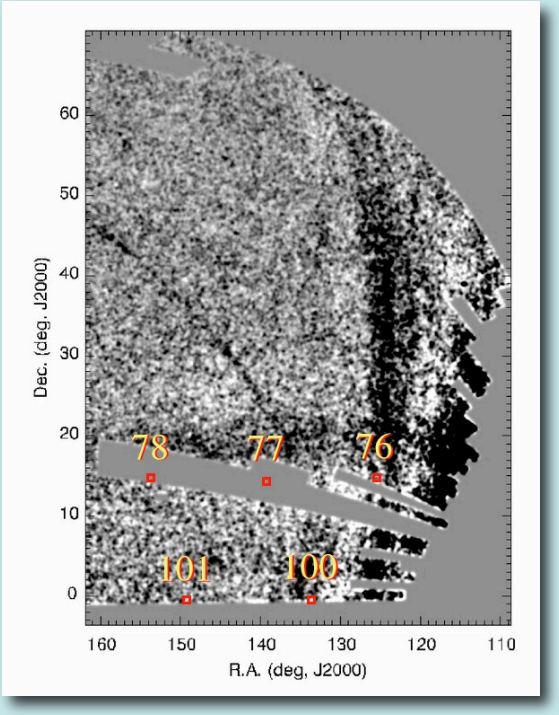
Combine early ODI observations with existing high-quality photographic material, and with existing/soon-to-be taken OPTIC observations.

<u>Specific targets:</u>

- Draco dSph (~1970s Hale 60 and 200inch plates)
- NGC 5466, NGC 6229 (~1970s Hale 60 and 200-inch plates)
- M 13, M 15, M 2 (OPTIC)
- Kapteyn Selected Area (SA) fields

  along $\delta = 0^o, +15^o, -15^o$

  (~1996 du Pont 2.5m plates, Mayall 4m plates)



Grillmair 2006, SDSS DR4